MAXIMUM GERMINANTS/UNIT OF SEED AS A TOOL FOR CALCULATING BAREROOT AND CONTAINER SOWING CALCULATIONS

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ABSTRACT: The concept of Maximum Germinants per unit of seed (MG/unit) recognizes the fact that the germination percentage used in sowing calculations is directly related to a particular stratification treatment. By including the stratification requirements for a seed lot into the sowing calculations, MG/unit of seed helps to improve the correlation between laboratory and actual nursery germination.

INTRODUCTION

Maximum Germinants/unit of seed is defined as the amount of live, normal germinants to be obtained under favorable germination conditions from a unit of stratified seed. Maximum Germinants per unit of seed can be expressed in pounds, kilograms, or total seed lot. For purposes of this paper, Maximum Germinarts per pound (MG/lb) will be used.

In order to calculate the MG/lb of a given seed lot, we need to know the percent of germination and what stratification treatment was used to obtain this figure. Also needed is seed/lb, the percent of purity, and the percent of filled seeds in the seed lot. The percent of germination is actually a percentage of "apparent" germination which is the number of germinants as a proportion of all the seed in the sample (Edwards 1982). The type and duration of the stratification technique which the seed lot is subject to is directly related to the number of germinants obtained. The number of seeds per unit of seed (pounds, kilograms, or seed lot) is a function of seed size, moisture content (fresh weight basis), and the percent of filled seeds in the lot. Therefore, the lower the percent of filled seed, the greater the possibility of getting an inflated seed/unit figure. By including the percent of filled seed in the sowing formula, compensation for inflated seed/unit figures in lots with a high amount of hollow seed is accomplished. MG/unit of seed differs from Pure Live Seed (PLS) by the fact that it is tied directly to the type and duration of stratification technique that the particular seed lot was subject to, and also because it includes the percent of filled seed in the sowing calculation.

MG/lb = % of germination (under _____ stratification) X seed/lb X % pure seed X % of filled seed

Paper presented at combined meeting of the Western Forest Nursery Council and Intermountain Nurseryman's Association, Coeur d'Alene, ID, August 14-16, 1984.

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LABORATORY TESTS

Laboratory seed germination test results are used to objectively evaluate a seed lot and to determine the sowing rates in the nursery. To obtain the necessary information to arrive at MG/unit of seed, a germination test is needed. Most laboratory germination tests are conducted with methods based on rules of the Association of Official Seed Analysts (AOSA) and/or the International Seed Testing Association (ISTA). Both AOSA and ISTA rules recommend that the seed testing of Douglas-fir and noble fir, for example, should be double test (with and without pre-chill), and that the pre-chill period should be 21 days (Anon. 1976, 1978). AOSA and ISTA recommendations for testing tree seed are good as a "referee" type of test. Referee testing is defined as comparative tests of the same lot using the same treatments at the same time (Edwards 1982). This type of seed testing is very useful for purposes of commercial trading and as an objective way to evaluate a seed lot. It does not, however, provide information on the ideal stratification treatment that the nursery grower needs in order to maximize the amount of pack-out seedlings obtained from a seed lot sown in the nursery.

According to the OSU Nursery Survey (Duryea and Landis 1984), in the Northwest, stratification periods vary from nursery to nursery. In the nurseries that responded to the survey, Douglas-fir and noble fir seed lots are subject to stratification periods that vary from 28 to 90 days. This variance between the nurseries' pre-sowing stratification treatments (28 to 90 days) and the 21-day chill treatment in the seed laboratory may explain why, in some cases, the germination reported by the seed laboratory correlates very poorly with the actual nursery seedling emergence. To complicate matters a little more, all nurseries responding to the OSU survey use some type of "naked stratification." Naked stratification is when the seed is soaked in a plastic bag or other suitable container for 24 to 48 hours, drained of excess water, and placed at a low temperature for a predetermined period of time. Not all of the seed laboratories give the seed samples a water soak stratification when doing the chill part of the germination test. Some seed laboratories place the dry seed on top of a moist medium and then proceed to place the sample in a cooler at low temperatures. Therefore, not only the duration but, in some cases, not even the type of stratification is being duplicated between the nursery and the seed laboratory.

SEED LOT RESPONSE

Seed lots are unique in that they come from different geographic areas, elevations, slope exposures, crop years, and maturity levels at the time of harvesting. Also, the processing techniques and storage conditions which they have been subject to might have been different from seed lot to seed lot. Therefore, seed lots from a given tree species will not always respond similarly to a particular stratification treatment prior to sowing. If the objective is to maximize the germination capacity of a seed lot and influence its germinative energy peak so this germinative energy will occur soon after sowing, we need to properly identify the best stratification technique for each seed lot. That can be done in the seed laboratory at the time of doing the germination test by conducting more than one type of pre-chill treatment per seed lot tested. In doing more than one pre-chill treatment, it is evident that some of these variations will show a significant increase in total germination over the standard 21-day chill referee test. It is this kind of "custom seed testing" that the grower needs in order to arrive at more accurate sowing calculations. Also, with this kind of stratification information, the nursery person can decide which stratification treatment is the most advantageous based on the nursery's own particular growing objectives. For example, the grower might be concerned with a very rapid germination (even if it comes at the expense of the total germination capacity of the seed lot) since rapid germination patterns none a strong influence on the final pack-out seedling yield and quality. In another situation, the nursery might not have enough seed from a particular valuable seed lot and the grower would be interested in maximizing the total. germination capacity of the seed lot in order to get as many seedlings from the seed lot as possible.

For bareroot nurseries, the use of MG/unit of seed can simplify the sowing calculations. If the information needed is how many pack-out seedlings can be obtained from a given unit of seed, then MG/unit of seed (being pounds, kilograms, or seed lot) needs to be multiplied by the specific survival factors of the nursery for that particular tree species and seedling type . A problem may arise, as suggested by Thompson (1984), by the fact that nursery survival factors used in the sowing formula are, "at best, an average of many years of experience and, at worst, a conservative educated guess." In the best of cases, when survival factors have been recorded over a period of years, in an average year the actual pack-out seedlings should be very close to the expected seedling yield. Now, in the situation where there is not much information available and the grower is forced to make a guess, the concept of MG/unit of seed can play a helpful role in actually identifying more closely the actual survival factors of the nursery. If the grower knows how many germinants he/she can potentially get from the seed lots sown under ideal conditions, at the end of the growing period the grower can divide the pack-out number of seedlings by the MG/seed lot and the result will be a survival factor for that particular seed lot, that particular year. For example, if the MG/seed lot was 160,000 but the final pack-out figure was only 80,000 seedlings: 80,000 divided by 160,000 equals .5 or 50 percent survival.

MG/UNIT EXAMPLES

The following is an example of how the concept of MG/unit of seed was used in a bareroot nursery. The seed lot was collected, tested, and stratified by Syverson Seed, Inc., Ridgefield, Washington, and sown at the J. Hofert Forest Nursery, Olympia, Washington, in May of 1984.

Seed lot used ..... noble fir 440-3.5-82
expected pack-out ...47,300 (2+0 seedlings)
seed per pound 12,250
seed purity ..... 98.8 percent
filled seeds ..... 80 percent

In order to properly identify the most favorable stratification treatment, a custom germination test was done. In addition to the standard no-chill germination test, four more tests were done, each with a different treatment (table 1).

Table 1.-- Variable chill treatment used in a custom germination test in order to determine the most advantageous stratification treatment for a noble fir seed lot

Test A. - no chill treatment
Test B. - 30 days moist chill treatment
Test C. - 60 days moist chill treatment
Test D. - 30 days moist, surface dried and then 30 days dry chill treatment (30/30)
Test E. - 50 days moist, surface dried and then 40 days dry chill treatment (50/40)

The results from this test, expressed in total percentage of apparent germination (fig. 1), showed that the stratification treatment applied to test "D" resulted in a significant increase in total germination over the other treatments and that its germinative energy peak was in the first 14 days of the test.

With the available germination data, the sowing rates were calculated:

- .62 germ. (30/30 strat) X 12,250 seed/lb X .988 seed purity X .80 filled seed = 6,003 MG/lb

- 6,003 MG/lb X .75 (mortality 1st year) X .80 (mortality 2nd year) X .90 (cull factor) = 3,241 pack-out seedlings/lb of seed

- 47,300 expected yield ÷ 3,241 seedlings/lb = 14.6 lb of seed needed

On May 15, 1984, the seed lot was sown using a Wind River seed drill over 528 linear bed feet. The density per square foot was:

- 47,300 seedlings ÷ 528 bed feet = 89.6/bed foot

- 89.6 seedlings/bed foot ÷ 4 sq ft/bed ft = 22.4 pack-out seedlings/square foot

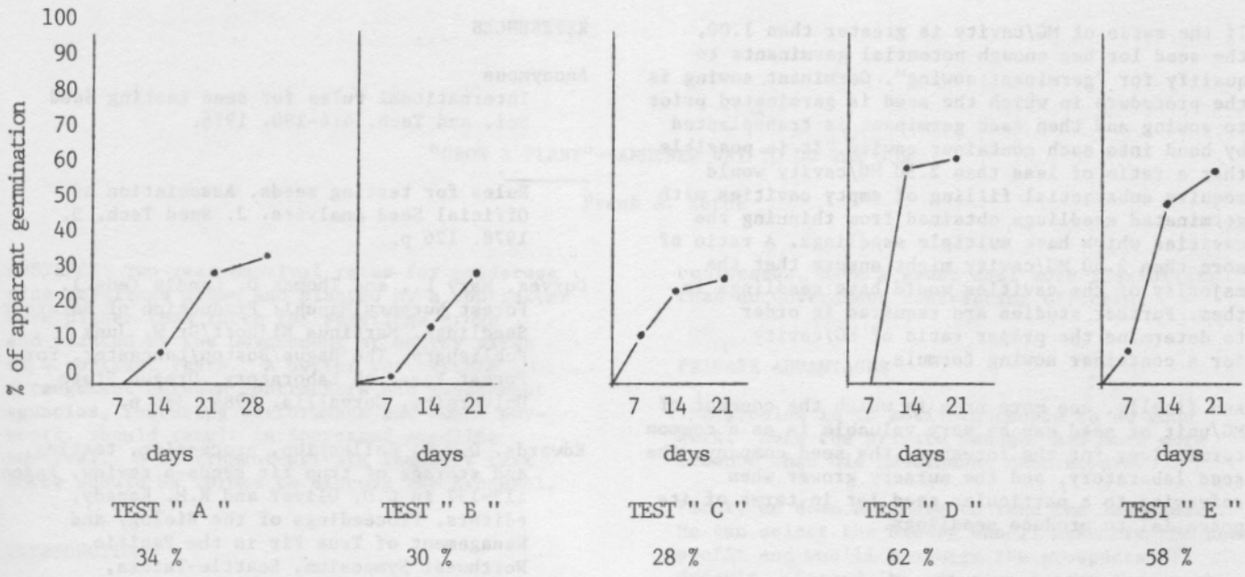

Figure 1.-- Percent of germination obtained under different chill treatments for a noble fir 440-35-82 seed lot.

To verify the actual survival factors in the nursery, a test plot of 2 linear bed feet was set up in order to monitor field germination.

- 6003 MG/lb X 14.6 lb seed - 87,643 MG/seed lot

- 87,643 : 528 bed ft. - 166 MG/bed ft X 2 bed/ft = 322 MG/2 bed feet test plot

Seedling emergence was first recorded 15 days after sowing and from then on every 7 days until germination was completed (table 2). In the first 37 days after sowing, there was very little mortality (two seedlings) and the correlation between the actual test plot seedling emergence (342 seedlings) and the expected maximum germinants in the test plot (332 germinants) was very close. Also, the germinative energy peak shown in test "D" was very similar to the one experienced in the test plot (fig. 2).

In a container nursery, the concept of MG/seed lot can be very useful in determining whether or not there are enough potential germinants for the number of cavities that need to he sown. For example, the following seed lot was sown at the Syverson Seed container facilities in Ridgefield, Washington, in March of 1984.

seed lot .....noble fir 452-35-78
total seed lot ...146 lb
total cavities...214,560 styro 2A cavities

- MG/seed lot - 146 lb X .18 germination (under 30/30 stratification) X 13,594 seed/lb X .97 seed purity X .74 filled seed - 256,376 MG/seed lot

- 256,376 MG + 214,560 cavities = 1.19 MG/cavity

Table 2.-- Field germination of the NF 440-35-82 seed lot in the test plot at the J. Hofert Forest Nursery

15 days after sowing -	73 seedlings	
22 days after sowing -	224 seedlings	
29 days after sowing -	306 seedlings	
37 days after sowing -	342 seedlings	(-2)[1]
44 days after sowing -	333 seedlings	(-9)[1]
51 days after sowing -	332 seedlings	(-1)[1]

[1]Dead seedlings since last count.

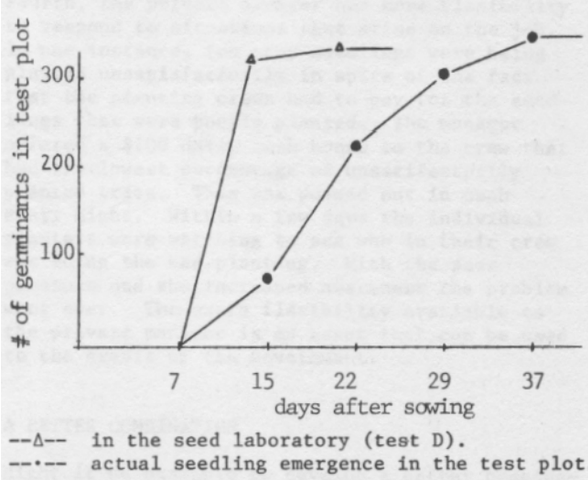

Figure 2.-- Comparison of the germinative energy peak between the laboratory germination test "D" and the seedling emergence in the test plot.

If the ratio of MG/cavity is greater than 1.00, the seed lot has enough potential germinants to qualify for "germinant sowing". Germinant sowing is the procedure in which the seed is germinated prior to sowing and then each germinant is transplanted by hand into each container cavity. It is possible that a ratio of less than 2.50 MG/cavity would require substantial filling of empty cavities with germinated seedlings obtained from thinning the cavities which have multiple seedlings. A ratio of more than 2.50 MG/cavity might ensure that the majority of the cavities would have seedlings in them. Further studies are required in order to determine the proper ratio of MG/cavity for a container sowing formula.

And finally, one more area in which the concept of M.G/unit of seed can be very valuable is as a common terminology for the forester, the seed company, the seed laboratory, and the nursery grower when referring to a particular seed lot in terms of its potential to produce seedlings.

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